PRÜFSTELLE TEXTIL

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Von der Federation Internationale de L´Automobile (FIA) Paris zugelassene Stelle zur Prüfung von hitze- und flammresistenter Schutzkleidung für Auto-Rennfahrer gemäß Standard FIA 8856-2000

UNTERSUCHUNGSBERICHT I TESTREPORT

Order No. STFI:	**2016 1276**
Order No applicant :	
Date of Test-Report:	08 August 2016
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Responsible officer:	Böhme
Applicant:	ITURRI Group Roberto Osborne 5 41007 Sevilla Spain

Testing application:

as of:	19 May 2016
order receipt on:	06 June 2016
sample receipt on:	06 June 2016 / 13 June 2016 / 02 August 2016

Vorstandsvorsitzender
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Test specimen: **Multi** Protective clothing Thunder Plus 3D and Thunder Plus

Marking by applicant	Coding for testing	Coding for arc test
Multifunction Jacket Thunder Plus 3D Jacket two-coloured, article 111.111 size S (44) and L (52), complete double layer construction reflective stripes are patched 5 cm wide in braces design, with hood front closure with plastic zipper and double cover plate, and Velcro in the following colour combinations article 111.111 hi-vis yellow/anthracite article 111.112 hi-vis yellow/ navy article 111.121 hi-vis orange/ anthracite article 111.122 hi-vis orange/ navy	**sample 01** 	**16-DP1**
Multifunction Jacket Thunder Plus 3D Jacket two-coloured, article 112.222 size S (44) and L (52), complete double layer construction reflective stripes are patched 5 cm wide, with hood front closure with plastic zipper and double cover plate, and Velcro in the following colour combinations article 112.211 hi-vis yellow/anthracite article 112.212 hi-vis yellow/ navy article 112.221 hi-vis orange / anthracite article 112.222 hi-vis orange / navy	**sample 02** 	

Multifunction Jacket Thunder Plus

sample 03

Jacket two-coloured, article 112.312
size S (44) and L (52),
complete double layer construction
reflective stripes are patched 5 cm, with
hood, front closure with plastic zipper
and double cover plate, and Velcro

in the following colour combinations
article122.310 hi-vis yellow
article I 122.311 hi-vis yellow /anthracite
article 122.312 hi-vis yellow / navy

article 122.320 hi-vis orange
article 122.321 hi-vis orange / anthracite
article 122.322 hi-vis orange / navy
article 122.333 hi-vis red / anthracite

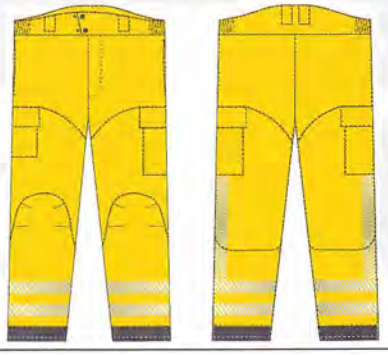
Multifunctional trouser Thunder Plus 3D

sample 04

Trouser, Article 213.411,
Size S (44) and Size L (52),
complete double layer construction
reflective stripes are patched, 6 cm wide

in the following colour combinations
article 213.411 hi-vis yellow/anthracite
article 213.412 hi vis yellow/ navy

article 213.421 hi-vis orange/ anthracite
article 213.422 hi-vis orange/ navy



Multifunctional trouser
Thunder Plus 3D

Trouser, Article 313.422,
Size S (44) and Size L (52),
complete double layer construction
reflective stripes are patched, 6 cm wide

in the following colour combinations
article 313.421 hi-vis orange/anthracite
article 313.422 hi vis orange/ navy

article 313.411 hi-vis yellow/ anthracite
article 313.412 hi-vis yellow/ navy

article 313.433 hi-vis red/ anthracites

sample 05

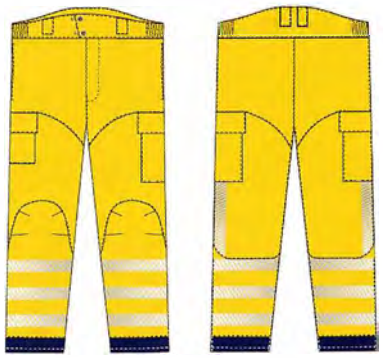
Multifunctional trouser
identical to sample 04 within 3 reflective stripes Thunder Plus 3D

Trouser, Article 313.422,
Size S (44) and Size L (52),
complete double layer construction
reflective stripes are patched, 6 cm wide

in the following colour combinations
article 313.421 hi-vis orange/anthracite
article 313.422 hi vis orange/ navy

article 313.411 hi-vis yellow/ anthracite
article 313.412 hi-vis yellow/ navy

article 313.433 hi-vis red/ anthracites



Material–Combination 1 2-layer consist of: **16-DN1 und 16-DN2**
Outer material:
2-layer Laminate GORE-TEX® Ebro
99,4% PES / 0,6% Carbon with GORE® PYRAD®
Fabric Technology / Membrane ePTFE,
approx. 215 g/m², W.L.GORE color hi-vis orange sample 06
color hi-vis yellow sample 07
color navy sample 09
color anthracite sample 10

Inner layer alternatively:
50% Meta Aramid / 50% Viscose FR, ca. 120g/m²
1. woven fabric article Techs 8750 Jumbo sample 11
2. woven fabric article Aravis CT sample 13

Jacket-, sleeves- and Trouser flap consist of **16-DO1 bis 16-DO4**
approx. 10cm material combination 2 – double layer:
2-layer Laminate GORE-TEX® Ebro, approx. 215g/m²,
(Membrane of Membrane)

Reflective material:
Scotchlite 5535 / 8735 flame retardant, company 3M

Patch label article Trans Plast 60 FR sample 12
flame retardant, AS System
patched on 2-layer laminate color hi-vis orange

Design „Netze NGO" small approx. 10cm x 2,5cm
Design „Netze BW" tall approx. 22cm x 5,2cm

Seam material:
Amann N-tech 70cs meta Aramid

The sampling happened by the applicant. There is no information about the sampling method.

Testing method/testing conditions:

EC type-examination according to EN ISO 11612:2015, EN ISO 11611:2015, EN ISO 20471:2013, EN 343+A1:2007, EN 13034+A1:2009 in connection to EN 14325:2004, EN 1149-5:2008 in connection with EN 1149-3:2004, IEC 61482-2 Ed.1 2009 in connection with IEC 61482-1-2 Ed.2:2014 and EN 340:2003, withdrawn and replaced by EN ISO 13688:2013.

Pre-treatment:
5 washing cycles 60°C according to EN ISO 6330:2012, method 6N+F

Property – Fabric		**Test method** [1)]
EN ISO 11612: Heat resistance / shrinkage after pre-treatment		ISO 17493:2000, 5 minutes, (180 ± 5) °C
Limited flame spread - code A1 fabric new and after pre-treatment	(e)	EN ISO 15025:2002, method A surface ignition, flaming time 10 s
Dimensional change after 5 washing cycles	(e)	EN ISO 5077:2008/ EN ISO 3759:2011
Tensile strength after pre-treatment		EN ISO 13934-1:2013
Tear strength after pre-treatment		EN ISO 13937-2:2000
Seam strength after pre-treatment	(e)	EN ISO 13935-2:2014
Convective heat - code B after pre-treatment	(e)	ISO 9151:1995
Radiant heat - code C after pre-treatment	(e)	EN ISO 6942:2002, q_0= 20 kW/m²
Molten aluminium splash - code D after pre-treatment		EN ISO 9185:2007
Molten iron splash - code E after pre-treatment	(e)	EN ISO 9185:2007
Contact heat - code F after pre-treatment	(e)	ISO *12127-1:2015,* *alternative tested according to EN 702:1995,* Contact temperature T_C = 250°C

Property – Fabric		**Test method** [1)]
EN ISO 11611:		
Tensile strength after pre-treatment	(e)	EN ISO 13934-1:2013
Tear strength after pre-treatment	(e)	EN ISO 13937-2:2000
Seam strength after pre-treatment		EN ISO 13935-2:2014
Dimensional change after 5 washing cycles	(e)	EN ISO 5077:2008/ EN ISO 3759:2011
Limited flame spread - A1 fabric new and after pre-treatment	(e)	EN ISO 15025:2002, method A surface ignition, flaming time 10s
Small hot metal drops after pre-treatment		ISO 9150:1988
Heat transfer radiation after pre-treatment	(e)	EN ISO 6942:2002, q_0= 20 kW/m²
Vertical resistance R_V after pre-treatment		EN 1149-2:1997 Test condition: relative humidity (85 ± 5)% temperature (20 ± 2)°C
EN ISO 20471:		
Colour new after xenon test and after **5** care cycles at ready garment		CIE 15:2004
Dimensional change after 5 washing cycles		EN ISO 5077:2008/ EN ISO 3759:2011
Tensile strength (fabrics/ laminates)		EN ISO 13934-1:2013 / EN ISO 1421:1998
Tear strengtht (laminate)		EN ISO 4674-1:2003, method A
Colour fastness to rubbing (dry) Colour fastness to perspiration (alkaline / acid) Colour fastness to laundry 60°C Colour fastness to dry cleaning Colour fastness to hypochlorite bleaching Colour fastness to hot pressing		EN ISO 105-X12:2002 EN ISO 105-E04:2013 EN ISO 105-C06:2010, method C2S EN ISO 105-D01:2009 EN 20105-N01:1995 EN ISO 105-X11:1996
Water vapour resistance, Ret		EN ISO 11092:201
EN 343:		
Water penetration resistance Fabric before pre-treatment after washing after abrasion after repeated flexing after pre-treatment by fuel/oil Seam before pre-treatment	(e)	EN 20811:1992 EN ISO 6330:2012 EN 530:1994 V2, 1000 cycles EN ISO 7854:1997, method C, 9000 cycles EN 343 + A1:2007, point 5.1.3.5 EN 343+A1:2007, point 4.2
Water vapour penetration resistance	(e)	EN ISO 11092:2014
Tensile strength (fabrics/ laminates)	(e)	EN ISO 13934-1:2013 / EN ISO 1421:1998
Tear strength (laminates)	(e)	ISO 4674-1:2003, method A
Dimensional change after 5 washing cycles	(e)	EN ISO 5077:2008/ EN ISO 3759:2011

Property – Fabric		**Test method** [1)]
Seam strength		EN ISO 13935-2:2014
EN 13034:		
Abrasion resistance after pre-treatment	(e)	EN 530:2010, method 2, 9 kPa, paper 00
Tear resistance after pre-treatment	(e)	EN ISO 9073-4:1997
Tensile strength after pre-treatment	(e)	EN ISO 13934-1:2013
Puncture resistance after pre-treatment	(e)	EN 863:1995
Resistance against penetration by liquids chemicals after pre-treatment	(e)	EN 368:1992 *withdrawn* *tested according to EN ISO 6530:2005* chemicals: H_2SO_4 30% NaOH 10% o-xylen undiluted Butan-1-ol undiluted
Seam strength after pre-treatment		EN ISO 13935-2:2014
Dimensional change after 5 washing cycles	(e)	EN ISO 5077:2008/ EN ISO 3759:2011
EN 1149-5:		
Electrostatic dissipative behaviour after pre-treatment	(e)	EN 1149-3:2004, method 2 Test condition: relative humidity (25 ± 5)% temperature (23 ± 1)°C
Dimensional change after 5 washing cycles	(e)	EN ISO 5077:2008/ EN ISO 3759:2011
IEC 61482-2:		
Limited flame spread after pre-treatment	(e)	EN ISO 15025:2002 surface ignition, flaming time 10s
Heat resistance of sewing thread	(e)	EN ISO 3146:2000 *alternative tested with Leica Heating table microscope Gahlen III" heat-up speed 4°C/min*
Tear strength after pre-treatment	(e)	EN ISO 13937-2:2000
Tensile strength after pre-treatment	(e)	EN ISO 13934-1:2013
Dimensional change after 5 washing cycles	(e)	EN ISO 5077:2008/ EN ISO 3759:2011
Arc thermal resistance requirements after pre-treatment		IEC 61482-1-2 Ed.2:2014, Test procedure for fabrics class 2
EN 340 / EN ISO 13688 - innocuousness:		
pH value	(e)	EN 1413:1998 *withdrawn* *tested according to EN ISO 3071:2006*
Colour fastness to perspiration (alkaline / acid)	(e)	EN ISO 105-E04:2013
Amines derived from AZO colorants	(e)	EN 14362-1:2012

1) if available, the actual valid standard edition in German, identical to the international ones, is used for testing

Property hardware/seams (closures, reflective stripes, accessories)		**Test method** [1)]
Heat resistance - shrinkage after pre-treatment	(e)	ISO 17493:2000, 5 minutes, (180 ± 5) °C taken from ready garment
Limited flame spread after pre-treatment	(e)	EN ISO 15025:2002, method A surface ignition, flaming time 10 s taken from ready garment

Property retroreflective material		**Test method** [1)]
Retroreflective performance	(e)	CIE 54.2 *
New material	(e)	EN ISO 20471:2013, point 6.1, table 4 and 5
After exposure	(e)	EN ISO 20471:2013, point 6.2.1, table 6
Abrasion	(e)	EN ISO 12947-2:2007, 9 kPa, wool, 5000 cycles
Flexing	(e)	EN ISO 7854:1997, method A, 7500 cycles
Folding at cold temperature	(e)	ISO 4675:1990, (-20 ± 1)°C ** (out of accreditation scope of the test house)*
Temperature variation	(e)	EN ISO 20471:2013, point 7.4.4, 12 h +50 ° / 20 h - 30 °C
Washing		EN ISO 6330:2012, method 6N+F
Dry cleaning	(e)	EN ISO 3175-2:2010, method according to pt. 7.5.3
Influence of rainfall	(e)	EN 20471:2013, annex C

Property – garment		**Test method** [1)]
Specific design requirements Amount of visible materials		EN ISO 20471:2013
Spray-test after pre-treatment	(e)	EN ISO 17491-4:2008, method A; in connection with EN 13034+A1:2009
Whole garment test after pre-treatment		Test method STFI No. PS 07 Version 12/10 Rev. C *"Test method to determine the body potential and the charge transfer by wearing of electrostatically dissipative protective clothing"*
Arc thermal resistance requirements after pre-treatment	(e)	IEC 61482-1-2 Ed.2:2014, Test procedure for garments class 2
General requirements and Design		EN ISO 11612:2015/ EN ISO 11611:2015/ EN 13034+A1:2009/ EN 1149-5:2008/ IEC 61482-2:2009/ EN ISO 13688:2013
Ergonomics		EN 340:2003 *withdrawn and replaced by* EN ISO 13688:2013

Property – garment	**Test method** [1)]
Sizes/ fit	EN 340:2003 *withdrawn and replaced by* EN ISO 13688:2013
Care behaviour	EN 340:2003 *withdrawn and replaced by* EN ISO 13688:2013 EN ISO 6330:2012, method 6N+F
Release of Nickel from metal parts which could come into prolonged contact with the skin (e)	EN 1811:1998*

1) if available, the actual valid standard edition in German, identical to the international ones, is used for testing

Test results:

Test results partly adopted from the following Test Reports/ Certificates:
Test Report Aitex No. 2015CO4269 dated 2016-01-19
Test Report Aitex No. 2015CO4268 dated 2016-01-12
Test Report Aitex No. 2015CO4266 dated 2016-01-12
Test Report Aitex No. 2015CO4262 dated 2016-01-21
Test Report Aitex No. 2015CO4286 dated 2016-01-21
Test Report Aitex No. 2015CO4265 dated 2016-01-21
Test Report Aitex No. 2015CO4267 dated 2016-01-21
Test Report Aitex No. 2015CO4270 dated 2016-01-21
Test Report STFI No. 20152620 dated 2016-01-26
Test Report STFI No. 20160125 dated 2016-02-03
Test Report Hohenstein Laboratories No. 16.1.12.0340 dated 2016-03-21
Test Report Aitex No. 2015CO4260 dated 2016-01-12
Certificate of test 241741A01 dated 2013-10-04
DGUV Test Certificate No. IFA 1304177 dated 2013-09-30
Test Report Aitex No. 2012CO2728 dated 2013-01-15
Oeko-Tex-Certificate No. 980887 dated 2015-09-16
Missing properties were extended and relevant properties were re-tested.

Property – fabric	**Dimension**	**Test results** 2-layer laminate Ebro + Inner lining
EN ISO 11612:		
Heat resistance shrinkage 180°C		2-layer laminate / inner lining
lengthwise	%	fabric 1 / fabric 2
across	%	- 0,6 / - 1,8 / - 2,0
		- 1,3 / - 0,6 / - 1,3
melting, dripping, ignition		no / no
Limited flame spread - code A1		new
Surface ignition		*lengthwise* / *across*
Further flaming to top or sides		no / no
Flaming or melting debris		no / no
Hole formation		no / no
Afterflame time	s	0 / 0
Afterglow time	s	0 / 0

Property – fabric		**Dimension**	**Test results** 2-layer laminate Ebro + Inner lining
Limited flame spread - code A1 Surface ignition			after pre-treatment *lengthwise* *across*
Further flaming to top or sides			no no
Flaming or melting debris			no no
Hole formation			no no
Afterflame time		s	0 0
Afterglow time		s	0 0
			2-layer laminate Inner layer fabric 1 fabric 2
Dimensional change	lengthwise	%	- 0,5 -1,0 / - 2,2
	across	%	- 1,0 - 0,5 / - 1,1
Tensile strength	lengthwise	N	910
	across	N	840
Tear strength	lengthwise	N	27
	across	N	26
Seam strength		N	326
Convective heat - code B Heat transfer index HTI_{24} (mean)		s	11,2
Radiant heat - code C Heat transfer index $RHTI_{24}$ (mean)		s	17,8
Molten aluminium splash – code D Index		g	111
Molten iron splash – code E Index		g	66
Contact heat – code F Threshold time t_t (mean)		s	9,4
EN ISO 11611:			
Tensile strength	lengthwise	N	910
	across	N	840
Tear strength	lengthwise	N	27
	across	N	26
Seam strength		N	607
			2-layer laminate Inner layer fabric 1 fabric 2
Dimensional change	lengthwise	%	- 0,5 -1,0 / - 2,2
	across	%	- 1,0 - 0,5 / - 1,1
Limited flame spread - A1 Surface ignition			*new* *lengthwise* *across*
Further flaming to top or sides			no no
Flaming or melting debris			no no
Hole formation			no no
Afterflame time		s	0 0
Afterglow time		s	0 0

Property – fabric	**Dimension**	**Test results** 2-layer laminate Ebro + Inner lining
Limited flame spread - code A1 Surface ignition		after pre-treatment *lengthwise* *across*
Further flaming to top or sides		no no
Flaming or melting debris		no no
Hole formation		no no
Afterflame time	s	0 0
Afterglow time	s	0 0
Small hot metal drops (mean)	number drops to ΔT=40 K	> 35
Heat transfer (radiation) Heat transfer index $RHTI_{24}$ (mean)	s	17,8
Vertical resistance R_V	Ω	$1,1 \times 10^9$
EN ISO 20471: Colour new Chromaticity co-ordinates Luminance factor		Background material high vis yellow x= 0,3800 y= 0,5521 β= 0,91
Colour after xenon Chromaticity co-ordinates Luminance factor		x= 0,3760 y= 0,5338 β= 0,87
Colour after **5** care cycles Chromaticity co-ordinates Luminance factor		x= 0,3783 y= 0,5495 β= 0,89
Colour after **5** care cycles Chromaticity co-ordinates Luminance factor		hi-vis yellow combined with navy / anthracite x= 0,3753; y= 0,5457 β= 0,93
Colour new Chromaticity co-ordinates Luminance factor		Background material high vis orange x= 0,6027; y= 0,3632 β= 0,47
Colour after xenon Chromaticity co-ordinates Luminance factor		x= 0,5741; y= 0,3729 β= 0,50
Colour after **5** care cycles Chromaticity co-ordinates Luminance factor		x= 0,5948; y= 0,3635 β= 0,47
Colour after **5** care cycles Chromaticity co-ordinates Luminance factor		hi-vis orange combined with navy / anthracite x= 0,5886; y= 0,3731 β= 0,49

Property – fabric		**Dimension**	**Test results** 2-layer laminate Ebro + Inner lining		
Colour new Chromaticity co-ordinates Luminance factor			<u>Background material high vis red</u> x= 0,6113; y= 0,3344 β= 0,34		
Colour after xenon Chromaticity co-ordinates Luminance factor			x= 0,5883; y= 0,3456 β= 0,41		
Colour after **5** care cycles Chromaticity co-ordinates Luminance factor			x= 0,6059; y= 0,3326 β= 0,33		
Colour after **5** care cycles Chromaticity co-ordinates Luminance factor			<u>hi-vis red combined with navy / anthracite</u> x= 0,6039; y= 0,3339 β= 0,33		
Dimensional change	lengthwise across	% %	- 0,1 - 1,9		
Tensile strength	lengthwise across	N N	1039,0 908,5		
Tear strength	lengthwise across	N N	48,5 53,7		
Colour fastness <u>Background material</u> Colour fastness to rubbing (dry) staining		Rate	<u>hi-vis yellow</u> 4-5	<u>hi-vis orange</u> 4-5	<u>hi-vis red</u> 4-5
Colour fastness to perspiration alkaline and acid	colour change staining	Rate Rate	5 4-5	4-5 4	4-5 4-5
Colour fastness to laundry	colour change staining	Rate Rate	5 4-5	4-5 4-5	4-5 4-5
Colour fastness to dry cleaning	colour change staining	Rate Rate	5 4-5	4-5 4-5	4-5 4-5
Colour fastness to hypochlorite bleaching	colour change	Rate	4-5	4-5	4-5
Colour fastness to hot pressing	colour change staining	Rate Rate	5 5	4-5 4-5	4-5 4-5

Property – fabric		**Dimension**	**Test results** 2-layer laminate Ebro + Inner lining	
Colour fastness Contrast material			*navy*	*anthracite*
Colour fastness to rubbing (dry) staining		Rate	4-5	4-5
Colour fastness to perspiration alkaline and acid	colour change	Rate	-	-
	staining	Rate	4-5	4-5
Colour fastness to laundry	colour change	Rate	-	-
	staining	Rate	4	4-5
Colour fastness to dry cleaning	colour change	Rate	-	-
	staining	Rate	4-5	4-5
Colour fastness to hot pressing	colour change	Rate	-	-
	staining	Rate	4-5	4-5
			2-layer laminate Ebro + Inner lining	
Water vapour resistance		m² Pa/W	16,3	
EN 343:				
Water penetration resistance				
Fabric before pre-treatment		Pa	> 15 000	
Fabric after washing		Pa	> 15 000	
Fabric after abrasion		Pa	> 15 000	
Fabric after repeated flexing		Pa	> 15 000	
Fabric after pre-treatment by fuel/oil		Pa	> 15 000	
Seam before pre-treatment		Pa	> 15 000	
Water vapour resistance		m² Pa/W	16,3	
Tensile strength	lengthwise	N	937	
	across	N	754	
Tear strength	lengthwise	N	51	
	across	N	45	
			2-layer laminate	Inner layer fabric 1 fabric 2
Dimensional change	lengthwise	%	- 0,5	-1,0 / - 2,2
	across	%	- 1,0	- 0,5 / - 1,1
Seam strength		N	607	
EN 13034:				
Abrasion resistance		cycles	> 2000	
Tear strength	lengthwise	N	72,0	
	across	N	63,7	

Property – fabric		**Dimension**	**Test results** 2-layer laminate Ebro + Inner lining
Tensile strength	lengthwise across	N N	910 840
Puncture resistance		N	44,4
Resistance against penetration by liquid chemicals Repellency R/ Penetration P - H_2SO_4 30 % - NaOH 10 % - o-Xylen undiluted - Butan-1-ol undiluted		 % % % %	 R P 98,7 0,0 99,4 0,0 85,8 0,0 91,7 0,0
Seam strength		N	607
Dimensional change	lengthwise across	% %	2-layer laminate Inner layer fabric 1 fabric 2 - 0,5 -1,0 / - 2,2 - 1,0 - 0,5 / - 1,1
EN 1149-5: Half decay time t_{50} Shielding factor S		 s	 <0,01 0,72
Dimensional change	lengthwise across	% %	2-layer laminate Inner layer fabric 1 fabric 2 - 0,5 -1,0 / - 2,2 - 1,0 - 0,5 / - 1,1
IEC 61482-2: Limited flame spread further flaming to top or sides hole formation flaming debris afterglowing afterflame time		 s	 *lengthwise* *across* no no no no no no no no 0 0
Tear strength	lengthwise across	N N	27 26
Tensile strength	lengthwise across	N N	910 840
Dimensional change	lengthwise across	% %	2-layer laminate Inner layer fabric 1 fabric 2 - 0,5 -1,0 / - 2,2 - 1,0 - 0,5 / - 1,1
EN 340/ EN ISO 13688 - innocuousness: pH value			2-layer laminate 4,7
			Inner layer with Oeko Tex Certificate met
Colour fastness to perspiration		Note	4-5 met
Amines derived from AZO colorants			not detectable met

Property - fabric IEC 61482-1-2 Ed.2 – arc resistance	**Dimen-sion**	**Test results – Material combination 1** *2-layer laminate Ebro + Inner lining*			
		sample 1	**sample 2**	**sample 3**	**sample 4**
		class 2			
Afterflame time	s	0	0	0	0
Melting through to the inside		no	no	no	no
Hole formation		no	no	no	no
Time t_{max} of maximum temperature increase	s	30,0	30,0	30,0	30,0
Transmitted energy at time t_{max} on the back-side of the specimen (average)	kJ/m²	112,8	117,6	117,3	122,1
Allowed transmitted energy at time t_{max} to avoid 2nd degree burning (STOLL values)	kJ/m²	134,7	134,7	134,7	134,7
Exceeding of STOLL/Chianta curve at any moment during the measuring time		no	no	no	no
Acceptance criteria		met	met	met	met

Property IEC 61482-1-2 Ed.2 – arc resistance	**Dimen-sion**	**Test results – Material combination 1** *2-layer laminate Ebro + Inner lining*	
		16-DN1	**16-DN2**
		class 2	
Afterflame time	s	0	0
Melting through to the inside		no	no
Hole formation		no	no
Time t_{max} of maximum temperature increase	s	30,0	30,0
Transmitted energy at time t_{max} on the back-side of the specimen (average	kJ/m²	91,5	92,9
Allowed transmitted energy at time t_{max} to avoid 2nd degree burning (STOLL values)	kJ/m²	134,7	134,7
Exceeding of STOLL/Chianta curve at any moment during the measuring time		no	no
Acceptance criteria		met	met

Property - fabric IEC 61482-1-2 Ed.2 – arc resistance	**Dimen-sion**	**Test results – Material combination 2** *2-layer laminate Ebro double layer*			
		16-DO1	**16-DO2**	**16-DO3**	**16-DO4**
		class 2			
Afterflame time	s	0	0	0	0
Melting through to the inside		no	no	no	no
Hole formation		no	no	no	no
Time t_{max} of maximum temperature increase	s	30,0	30,0	30,0	30,0
Transmitted energy at time t_{max} on the back-side of the specimen (average)	kJ/m²	74,1	83,1	74,5	77,2
Allowed transmitted energy at time t_{max} to avoid 2nd degree burning (STOLL values)	kJ/m²	134,7	134,7	134,7	134,7
Exceeding of STOLL/Chianta curve at any moment during the measuring time		no	no	no	no
Acceptance criteria		met	met	met	met

Property hardware/seams (closures, reflect. stripes, accessories)	**Dimension**	**Test results**
Heat resistance shrinkage 180°C		Front closure
melting, ignition		no
closures capable of being 1x opened		yes
Heat resistance shrinkage 180°C		Patch Label
melting, ignition		no
Heat resistance shrinkage 180°C		Reflective stripe
melting, ignition		no
Limited flame spread - code A1		Front closure
Further flaming to top or sides		no
Flaming or melting debris		no
Afterglow time	s	0
Afterflame time	s	0
closures capable of being 1x opened		yes

Limited flame spread - code A1		Patch Label	
		small	*large*
Further flaming to top or sides		no	no
Flaming or melting debris		no	no
Afterglow time	s	0	0
Afterflame time	s	0	0

Property hardware/seams (closures, reflect. stripes, accessories)	**Dimension**	**Test results**
Limited flame spread - code A1		Reflective Stripe
Further flaming to top or sides		no
Flaming or melting debris		no
Afterglow time	s	0
Afterflame time	s	0
Limited flame spread - code A1		Seam
Further flaming to top or sides		no
Flaming or melting debris		no
Afterglow time	s	0
Afterflame time	s	0
Seam opened		no

Property – retroreflective material	**Dimension**	**Test result** article 5535 and 8735
Retroreflective performance in origin		met
Retroreflective performance after exposure of		
abrasion	cd/lx·m²	>100
flexing	cd/lx·m²	>100
folding at cold temperature	cd/lx·m²	>100
temperature variation	cd/lx·m²	>100
washing	cd/lx·m²	after 65 cycles >100 (article 5535) after 50 cycles > 100 (article 8735)
influence of rainfall	cd/lx·m²	>100

Property – garment	**Test results Thunder Plus**			
	Jacket Thunder Plus 3D article 111.111 111.112 111.121 111.122	Jacket Thunder Plus 3D article 112.211 112.212 112.221 112.222	Jacket Thunder Plus one colored article 121.310 121.320	Jacket Thunder Plus with contrast article 122.311 122.312 122.321 122.322 122.333
Amount of visible materials background material [m²] retro-reflective material [m²]	 0,82 0,26	 0,74 0,19	 1,02 0,17	 0,65 0,17
Combination with Trouser article Thunder Plus 3D series 213 background material [m²] retro-reflective material [m²]	 1,43 0,37	 1,36 0,30	 1,63 0,28	 1,26 0,28
Combination with Trouser article Thunder Plus 3D series 313 background material [m²] retro-reflective material [m²]	 1,16 0,37	 1,09 0,30	 1,36 0,28	 0,99 0,28
Design according to EN ISO 20471	met	met	met	met
Spray-test Penetration, sizes stain area	< 3 x calibrated stain area			
Whole garments test/ Charge transfer	no incendive discharge detectable			
Arc resistance class 2 Afterflame time Hole formation > 5 mm Melting through to the inside Functionality of the closure system	 0 s no no yes	 - - - -	 - - - -	 - - - -
General requirements and Design: Complete body cover Minimum overlap Skin contact No free metal parts No conductive connections Pockets Closure system Seams	in combination jacket with trousers Thunder Plus 3D met met met met met met met met	 met met met met met	 met met met met met	 met met met met met
Ergonomics and sizes	met			
Care behaviour	met			
Release of Nickel from metal parts which could come into prolonged contact with the skin	met – no contact to skin			

Property – garment	**Test results Thunder Plus**		
	Trouser Thunder Plus 3D article 213.411 213.412 213.421 231.422	Trouser Thunder Plus 3D article 313.411 313.412 313.421 313.422 313.433	Trouser Thunder Plus 3D article 313.511 313.512
Amount of visible materials background material [m²] retro-reflective material [m²]	 0,96 0,11	 0,61 0,11	 0,72 0,14
Design according to EN ISO 20471	met	met	met
Spray-test Penetration, sizes stain area	< 3 x calibrated stain area		
Whole garments test/ Charge transfer	no incendi ve discharge detectable		
General requirements and Design:	in combination with jacket Thunder Plus 3D or Thunder Plus		
Complete body cover		met	
Minimum overlap		met	
Skin contact	met	met	met
No free metal parts	met	met	met
No conductive connections	met	met	met
Pockets	met	met	met
Closure system	met	met	met
Seams	met	met	met
Ergonomics and sizes	met		
Care behaviour	met		
Release of Nickel from metal parts which could come into prolonged contact with the skin	met – no contact to skin		

Test results refer to the delivered specimen. Statistical information and cited test reports are available in the test house.
Results for test parameters marked with (e) were included in this test report from external test reports by the responsible officer of the procedure (page 1) and are not under responsibility of the Head of the Testing Department.
The testing period is defined as timeframe between receipt of samples and issue date of test report. This Test Report consists of 19 pages and shall not be published in parts.

i.V.

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